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THE UNIVERSITY OF TORONTO MEDICAL JOURNAL

(An Undergraduate Publication)

This journal is published seven times a year, November to May, by the Medical Society of the University of Toronto, to serve as a medium for student expression and to bring to the student recent articles of scientific interest.

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Volume XII TORONTO, JANUARY, 1935 Number 3

EDITORIAL

THE GRADUATING YEAR.

With the advent of the new year, those who are in their final year take up the final academic cudgels with mingled emotions. A certain joy is felt in the fact that examinations will soon be a thing of the past, a Nemesis that has taken six years to shake off. What freedom will there be. Once more a certain interest can be taken in the changing seasons, especially the Springtime which, heretofore has been a time, not of poetic flights of fancy but of rather arduous and terrifying labours. But in spite of the joy there is the problem of what to do after graduation. How many years should be spent in post graduate study? Is it Medicine or Surgery? theory or practice? Where is the best place to begin practice? When will one's income be a positive quantity, however small? Such questions must be answered, each according to his own abilities and qualifications with due regard having been paid to opportunities or circumstances which may arise. Those who have solved those problems are indeed fortunate. But there are many who have not and who must surely need help. Who shall give this help and advice? We have no hesitation in saying

the Medical Faculty. They have nursed us and cherished us through six chequered years and it would be large wonder if their interest suddenly waned at the expiration of that time. It does not—of that we feel very confident, and also very grateful.

Therefore we say, have you doubts and problems, appeal unto our Caesars. There are many who do not use this privilege, or do not know of it. But enough! Think upon these matters and prepare yourselves for the changing times.

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We are very sorry for the typographical error that crept into last month's issue in which it was stated that Dr. Donald F. Moore headed the honour list in the American State Board Examinations. Dr. Moore's name was spelled incorrectly, and so our apologies are tendered.

* * *

THE JOURNAL.

To date, two issues of the Journal have appeared and still we have had no criticism. Whether that can be taken as an indication of extreme satisfaction, rank apathy or mere indifference to the Journal cannot be judged until the appropriate noise is made. By all means, let us have your ideas on the subject, for at present the editors can only publish material which they think will be of interest but of which they cannot be really sure. We would welcome any criticism, either positive or negative—chiefly negative.

We also had considered the possibilities of publishing a list of what we considered the best articles in the Journal, covering the period from the time of its inception to the present. That is a task which proved impossible, for the diversity of subjects, all well handled and authoritative, both by Staff and students, would practically necessitate an index to the whole twelve volumes. We would like to draw attention to the articles on Paediatrics that have appeared in past years by Drs. Alan Brown, Silverthorn and Hawk. Also the very fine summary of Kanavel's book on the Anatomy and Common Infections of the Hand, by Harrison and Bastedo in Vol. IX, 1931-32 should be known. Lastly there is the very fine series of articles on Bright's Disease by Brien, Hendry and Kerr in Vol. X, 1932-33, which is a summary of the present status (or nearly so) of the conception of Bright's Disease as seen and taught in Toronto. Of course there may be minor changes, but in essence it is a very valuable series.

It would well repay one to look over the old volumes of the Journal in the Library. Old copies of the Journal may be had for the current price, but some of the issues are almost exhausted—so don't delay in procuring those back numbers that you would like to have.

* * *

EDUCATION AND MEDICINE.

At the risk of being told that our most intimate acquaintance is the March hare, nevertheless some discussion on the topic indicated seems to be of value.

Kipling writes that many people express their ideas according to some geometrical conception. It is not an unusual way of thinking and in some cases makes for clarity of the conceptions under discussion. For example, we feel that the various branches of medical and Scientific endeavours can be likened to the spokes of a wheel. Each worker is considered to be digging a deep ditch, with the various ditches radiating from a common ground. In such fashion scientific men dig these scientific ditches away from the central hub of common understanding. Each is working, deepening his own scientific ditch, spreading his knowledge and his terminology of the part under consideration.

Now, for the sake of completeness, let us insert the axil in this wheel

and let the spokes be at one end and the other end sticking up in the air. What about the axil? Only a very few people try to climb it. But when they do a view of the diversity of activity carried on in each spoke-ditch is appreciated, with the result that a more widespread comprehension of scientific endeavour is reached. The value of such a spy-hop lies in the fact that, with understanding of divers fields of knowledge, correlation can be made which would otherwise be obscured.

That is, in our studies, in relation to medicine we should aim to be leaders—leaders in the thinking processes of medicine, and in order to do so we must be familiar with all fields of scientific endeavour, and be able to perform correlation of data and ideas which will reduce the obscurity about our problems. That is how we must be leaders.

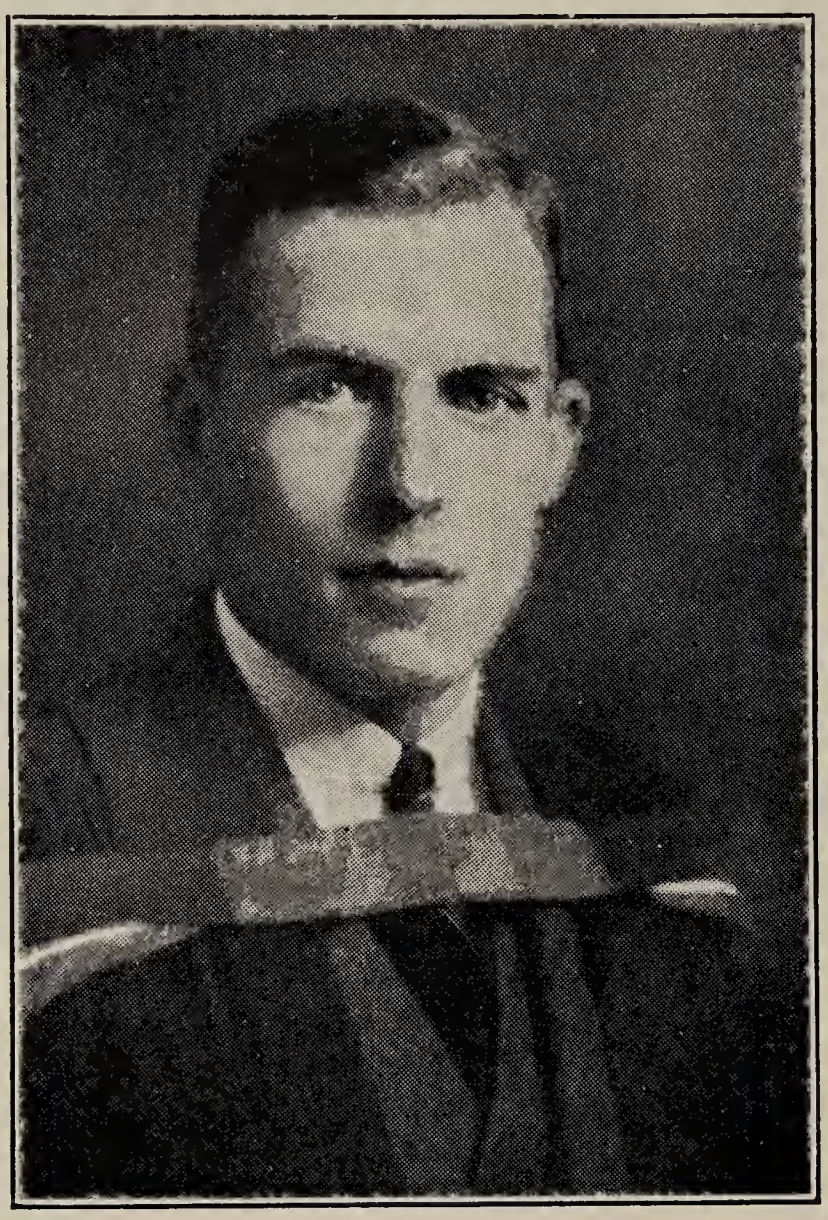
For instance, to take a familiar example, suppose we have collected together a biologist, a physicist, chemist, comparative anatomist, physiologist, pathologist and medical clinician, for the purpose of studying phases of calcium metabolism. Surely the problem would be advanced as a result of the focussing of these divers viewpoints on a single point. Surely there are none that would argue that the issue would be befogged! If such is the case, the logical conclusion is reached that since we cannot be all the above people at one and the same time, let us combine those fields of knowledge in ourselves. Obviously it is not meant that one should be a specialist in each of the above studies. That is impossible. But were a clinician of medicine familiar with the terminology and material of the other fields, so that he could discuss his own problem in the other man's territory, it is quite obvious that he is in a position to bring a tremendous body of knowledge to work on his own difficulties.

To come to the point, then, we say that one should study and read as much about all branches of science as is possible, in order to make our medical knowledge full, rounded, and in a position to develop into that mellow ripeness that comes with increasing knowledge and experience.

To acquire this extra bit of knowledge we must make an active effort of our own. We cannot expect to have everything taught to us. We are given a good training in medicine. Let us enrich that training in our spare moments with some measure of education. And by education we mean that delightful rag-bag of odd facts and theories that are of no seeming use, but pleasant withal. The very fact of their seeming uselessness makes them invaluable, for we tend to remember them and what is more, use them to great advantage.

The doctor in any community is looked up to—and looked upon as a man who knows a little more than the general run of people. Does he? Look to it, we say, that you do not become a medical Midas and by that damning touch convert this beautiful world of ours into nothing but clinical medicine!

RHODES SCHOLARSHIP



J. W. MAGLADERY.

The following of a Rhodes Scholarship to the Faculty of Medicine is a rare piece of good fortune that we do not often receive. It is therefore with great joy that we extend to J. W. Magladery, of Sixth Year, our heartiest congratulations on being the recipient of one of these most distinguished scholarships. By such an event, honor has been brought to us at home, and we feel sure will be carried abroad, for the very apt combination of executive ability, athletic power and academic vigor which are found in Mr. Magladery, enable him to take a place, a prominent place, wherever his sphere of activity may be situated. We feel confident that we have a Canadian student of the most sterling qualities and delightful character representing us at Oxford.

We wish you god-speed, Jack, and may the best fortune attend your efforts in this new academic venture upon which you will soon be setting forth.

ALEXANDER McPHEDRAN, M.B., M.D., LL.D., F.R.S.C., F.R.C.P.(C.)

AN APPRECIATION

By R. D. RUDOLF, C.B.E., M.D. Edin., F.R.C.P. Lond., F.R.C.P. (C.)

ALEXANDER McPHEDRAN, after a long and very active life, has left us, and many generations of his students, some of them so senior as to be almost termed aged, must feel that a great figure-head has gone.

After some years spent as a school teacher (an occupation so good as a training for the teacher as well as for his pupils), he entered the course of medicine in our University and graduated in 1879. He soon was engaged in teaching medicine, and this became his chief object in life, although he also built up a very large practice, first as a family doctor and then as a consulting psysician.

As a teacher he was unequalled, and innumerable practitioners recall the sound lessons which he drilled into them, often at the time much to their discomfiture, but later for their good. He had no use for slackers, and woe to the student who omitted any important detail from his case-history or who missed any evident physical sign. Never again would such omissions occur. An indelible impression had been made.

Dr. McPhedran was already a full physician to the Toronto General Hospital and to the Victoria Hospital for Sick Children when in 1900 he succeeded the late Professor J. E. Graham as head of the Department of Medicine in the University. From then on until his retirement in 1919 he made the work of the department his main object, and his tireless energy and marvellous organizing ability brought this department to the high state of perfection in which it was handed over to his successor.

Dr. McPhedran's fame as a skilled physician and teacher extended far beyond Toronto and Canada and he was awarded most of the honours that crown a successful career. A mere list of these would take too much space, but it may be mentioned that besides University honours he was elected a Fellow of the Royal Society of Canada (a rare distinction for a practising physician), was President of the Canadian Association and of the Association of American Physicians.

After his retirement from academic activity his numberless friends continued to group around him, and less than two weeks before his death many of them assembled at his home to wish him all good wishes on his 88th birthday. He looked well and it seemed as if he might last for long, but it was not to be and soon many were there again to pay their last respects to one whose going left a sad blank. But his influence will long remain and a veritable host of his old students will carry on on the sound lines that they learned from this great teacher.

THE EFFECT OF STONE DUST ON THE LUNGS

By T. H. BELT, M.B., B.Sc. (Med.)
Department of Pathology, University of Toronto.

It has long been recognized that the dust of hard rock exerts a harmful effect on the lungs when inhaled in appreciable quantities over long periods of time. Men who devote a life-time to mining, quarrying, granite-cutting, sandblasting, grinding, pottery or enamel work face the likelihood of having to retire relatively early in life, for it is part of the tradition of these dusty industries that the worker is prone to develop "lung trouble" which often turns into consumption and shortens his years.

The disease has gone by a number of different names, as miners' phthisis, grinders' rot, chalicosis, etc., but nowadays it is referred to almost exclusively as silicosis, because there has been reason to believe that silica (SiO_2) is the chief disease-producing element of stone dust. Of late, however, it has been questioned whether we are right in focussing our attention solely on silica; whether, in fact, the other constituents of hard rock, the silicates are not also culpable in the production of stone-dust disease. There is, therefore, much to be said for retaining the old expression chalicosis, used by Ziegler in 1880, which simply implies "impregnated with gravel," or the still more general term, pneumonoconiosis, introduced by Zenker in 1886, the literal meaning of which is "lung full of dust."

Whether or not silica has a specific effect on the lungs, and this point has been seriously questioned by Jones, Kettle, Cummins and others, it is rather striking that most of the common mineral dusts, chief of which are siliceous rock constituents, at first evoke much the same pathological reaction.

It is convenient to divide the reaction into four phases, remembering, of course, that the division is at best a rough one, and that the various phases overlap.

1. An initial, non-specific inflammation occurs as the result of contact of foreign particles with the lining membranes of the airways and the air sacs. The severity of this reaction is governed both by the quantity and the quality of the foreign material. More or less all the dusts of industry, while they may consist chiefly of one substance, are mixed to some degree and contaminated by particles of organic material. If the dust be particularly irritant or accompanied by pathogenic organisms a sharp inflammatory reaction my supervene in the form of bronchitis, bronchiolitis and bronchopneumonia. With lesser degrees of irritation milder reactions take place, mononuclear phagocytes instead of polymorphs migrate into the air-ways to take up the dust, lining cells are desquamated and excessive quantities of mucus secreted, the whole constituting a catarrhal reaction. As long as inhalation of dust continues bronchitis persists and undoubtedly small patches of broncho-pneumonia recur from time to time with the arrival of fresh dust deposits in the lung parenchyma. One of the peculiarities of a dust pneumonia is that it does not easily resolve; plugs of exudate containing many dust-laden phagocytes tend to undergo organization and form little balls of cellular connective tissue within alveolar ducts and atria and in the end this organization of exudate may account for much of the fibrosis which develops in the dust-ridden lung. In the absence of pneumonia or following its subsidence there is a continuous move on foot to rid the air sacs of dust-laden cells. Some of these cells become so overload-

ed with foreign particles that they loose amoeboid activity, are evacuated into the air-ways, carried up by the ciliary action of the bronchial mucosa and finally ejected by the cough reflex. More active phagocytes penetrate the alevolar walls and gain access to the lymphatic channels within the interstitial framework of the lungs.

2. **Lymphatic Stasis.**—In the second phase pneumonoconiosis becomes essentially a disease of the pulmonary lymphatics. In its lymphatic system the lung possesses an elaborate scavenger service which might be compared to the street cleaning system of a modern city. The lymphatic channels along the blood vessels and bronchi are like the streets, the phagocytes like the garbage men and their wagons, the lymph glands at the hylus and the lymph follicles in the pleura like the garbage disposal plants or incinerators.

Everyone reaching adult life has some accumulation of rubbish in the hylus glands and pleura. This results from the lifelong inhalation of smoke and the ordinary atmospheric dusts. and the accumulations increase with age. At autopsy one constantly finds a jet black pigmentation of the tracheobronchial glands, a black mottling of the pleura and a variable spotting of the intrapulmonic lymphatic channels. Ordinarily regarded as anthracotic pigmentation, the normal dust deposits contain something more than the black carbonaceous material. As long ago as 1898 a German medical student named Woskressensky[1] made chemical determinations on normal peribronchial glands and found appreciable quantities of stone dust (silica and silicates) mingled with the anthracotic material in them. It was he who established that normal adults have a chalicosis as well as anthracosis of the hylus glands. This fact is evidently not widely known, for, while practically all the text books of Pathology describe anthracotic pigmentation as of universal occurrence, none save Well's Chemical Pathology mentions the presence of silicon compounds in the "normal" dust deposits of the body. One would never suspect, in the ordinary histologic examination of anthracotic nodes that so many mineral particles were there because the soot is adsorbed to their surfaces and covers them completely. The particles are very small, averaging about the size of streptococci.

In confirmation of Woskressensky's work Dr. King and Dr. Irwin[2] of Dr. Banting's department have examined for me many anthracotic deposits from normal lungs and peribronchial glands and found them to contain surprising quantities of siliceous particles (silica and silicates). Evidently we all inhale considerable sand, clay and stone dust as well as soot, and curiously enough, when extracted, it is practically indistinguishable, save in quantity, from the dust which is recovered from silicotic lungs. But there is no appreciable fibrosis in relation to these normal dust deposits and as far as we know there is no ill effect resulting from them. They accumulate so gradually there is probably never any actual stasis or blocking of the lymphatic apparatus. However, we have to bear in mind that nearly every adult has an incipient penumonoconiosis and the disease, therefore, which results from excessive dust exposure, is really a hyperpneumonoconiosis.

For the purpose of illustrating what happens in the lung when excessive quantities of dust are inhaled let us draw further on the analogy and suppose that the allegorical street-cleaning system becomes overtaxed with excessive quantities of refuse showered from the heavens by a hurricane. Whether actual conflagrations broke out or not, undoubtedly the in-

1 This publication (Centralblatt für Allgemeine Patholigie 1898, 9, 296) was part of Woskressensky's graduation thesis and seems to have been his one and only contribution to the literature.

2 Publication in process of preparation.

itial effect would be an inflammatory reaction, at least in the minds of the street cleaning personnel. But let us neglect that phase of the reaction and observe how the emergency is to be dealt with. Large numbers of auxiliary collectors are pressed into service and soon all streets converging upon the disposal plant will become choked with loads of garbage. The capacity of the disposal plant is soon overtaxed, wagons pile up in the streets and the congestion extends farther and farther afield. Makeshift dumps must be set up both centrally and in the outskirts of the city whither the peripheral zones will be evacuated. Supposing the rain of refuse continues, the impatient carriers jamming the streets will soon be trampling over lawns and gardens so that the avenues of traffic become widened as well as more congested. A bird's eye view of the city then from an aeroplane, let us say, would show swollen, congested thoroughfares converging upon overtaxed disposal plants. And such is the microscopic appearance of a lung in the early stages of pneumonoconiosis. The tracheobronchial lymph nodes are usually prominent and jet black. *Whatever the nature of the dust, it nearly always contains enough carbonaceous material to colour it black.* The pleura is heavily mottled, the cut surface of the lung streaked and peppered with black deposits along the small blood vessels and bronchi. But unless the picture is complicated by pneumonia or carnification the lung retains its soft, spongy character and one is surprised at being unable to feel the dust deposits with the fingers. The glands, of course, are palpable, but even they do not become indurated until the process is further advanced. Insoluble, inorganic dusts of all kinds are extremely slow to produce connective tissue proliferation. Silica and silicates are no different from coal dust thus far in the reaction. But as in the case of the hypothetical street-cleaning system, further developments depend upon the ease with which the foreign material is disposed of, that is, whether it is combustible or soluble. The dust of stone, clay, sand, asbestos and coal are very inert and remain practically unchanged by the action of tissue juices, enzymes and phagocytes and they are therefore committed to storage in the lymphatic apparatus. By this time there are many improvised storage depots throughout the lung parenchyma as well as the over-filled depots at the hylus and in the pleura. But this is not necessarily a permanent state of affairs for the process of evacuation goes on and on in a constant effort to clear the intrapulmonic lymph channels. Given respite from further inhalation, much of the dust incarcerated in the afferent channels may be removed, or if oedema or acute inflammatory exudation occurs, the dust-laden phagocytes, though they may have remained for a long time inert, tend to become reactivated and migrate hyluswards or back into the air sacs again and are coughed up. It has often been noted that persons with heavy dust exposures bring up dust-streaked sputum long after removal from the dusty environment. Picture, however, the continual inhalation of more and more dust and it will be seen that eventually the evacuating forces are beaten and more or less complete stasis develops. It is now that the dangerous dusts begin to show their peculiarities and the third phase of the reaction sets in.

3. **Perilymphatic fibrosis.**—Prolonged contact of stone dust with the reticulum of the lymphatic apparatus leads eventually to an indolent proliferation of connective cells, first in the lymph glands and pleura, then in the loose areolar tissue around blood vessels and bronchi and in the interlobular septa (not alveolar septa!) of the lung. Peculiarly enough the tissue changes are quite unlike the ordinary foreign body reaction. The interstitial tissues holding the dust gradually thicken and nodular aggregations occur at the points of junction of various lymph

channels where small receptacula have been formed, particularly where blood vessels and bronchi bifurcate and where the interlobular septa join the pleura. These aggregations have been called "pseudotubercles," a term which is perhaps confusing and inapplicable because they have none of the histological characters of tuberculous lesions. "Intralymphatic plaques" is a better term. In the X-ray film they show up as "beading" along the linear shadows cast by the thickened lymphatic trunks. The dust-laden cells within these plaques lay down a fine network of recticular fibres and eventually collagen, thus giving rise to permanent lesions. With the proliferation of reticular cells and the formation of collagen the dust deposits become demonstrable to the touch, a factor of considerable importance, for it is only when the lesions are both visible and palpable that the presence of silicosis in a lung specimen becomes recognizable by the Compensation Law. The peribronchial glands are now firm and rubbery. On the cut surface of the lung the dusted foci stand out as palpable nodules, whereas in reality they are not nodules but simply the cut ends of thickened lymphatic trunks along the course of blood vessels and bronchi. Mavrogordato[3] has suggested the term "lymphatic cirrhosis" of the lung for this phase of the reaction, a term which commends itself because it aptly conveys the general character of the lesion. It is essentially a diffuse, interstitial fibrosis, affecting both lungs more or less uniformly.

So long as he remains free from infection the man with this much pneumonoconiosis suffers but little effect on his health. Probably the worst of his worries is a chronic bronchitis with a dry, hacking cough and likely some shortness of breath on exertion. Sooner or later, however, if indeed, he has escaped infection thus long, pathogenic organisms are carried in with the dust. Serious enough under any circumstances, pneumonia in a dust-ridden lung is a doubly dangerous affair, as has been indicated above, and not a few of these individuals come to their death by this means. Or if they recover, the lung often remains permanently scarred as a result.

The greatest and, unhappily, the most frequent hazard to be faced is tuberculous infection. There is some peculiar quality in stone dust which favours the fortunes of the tubercle bacillus, rendering the soil more fertile for its implantation and accelerating the course of the disease. It is said that all persons with silicosis will, if they live long enough, die eventually of tuberculosis.

There is however, one further phase of what is generally regarded as uncomplicated pneumonoconiosis through which the disease may progress.

4. **The stage of nodulation ("silicotic nodule").** — The more serious forms of pneumonoconiosis are characterized by the appearance of a lesion quite different from anything described up to this point. It consists of small fibrous nodules, firm, compact little spherules of dense collagen structure. If these nodules remain discrete the character of the lung is then as if it had been riddled with fine buck shot, but the more usual occurrence is the coalescence of several to form composite nodules of the size of a pea or larger. In contrast to the earlier changes which are scattered diffusely and symmetrically throughout both lungs, the nodular lesion tends to have an uneven distribution. Not infrequently composite nodules are so thickly placed in one part or another of the lung as to form a massive induration, perhaps replacing large areas of lung parenchyma. The nodules are of firm, rubbery consistency and iron-

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3 A. Mavrogordato, (Publ. So. Africa Inst. Med. Research 1922, No. 15, p. 112) one of the group of medical men in the Witwatersrand gold mining area, from which much of the present day knowledge of silicosis is derived.

grey to black in color. On the whole they are much less deeply pigmented than the perivascular and peribronchial aggregations or the intralymphatic plaques. Microscopically one finds the nodules often located in the interlobular septa or just beside the terminal bronchioles at the entrance to the lung lobules. It is often difficult to make out the exact location in relation to local topography but one pont is clear, namely, that the nodules are seldom attached to blood vessels or bronchi and they never have vessels running through them.

These lesions are practically indistinguishable from healed tubercles, and some people believe that is what they really are, but most authorities regard them as a specific dust lesion, the result of the action of silica. The lung may be riddled with these nodules and yet show not the slightest evidence of active tuberculosis; yet, on the whole they are most commonly found in association with tuberculous infection.

One striking peculiarity of the silicotic nodule is that its dust content varies quite markedly. It is not uncommon to find no foreign particles whatever in the central parts but there is usually considerable dust, both anthracotic and siliceous, around the outside of the lesion. Numerous attempts have been made to reproduce the silicotic nodule by dusting experimental animals and several researchers have claimed success. Perhaps I am all wrong but I doubt whether the typical lesion has ever been reproduced, except by Kettle[4] who mixed dead tubercle bacilli with siliceous dust and thereby induced, in guinea-pigs' lungs, fibrous nodules which seem to faithfully represent the human lesion.

As in the preceding phase of pneumonoconiosis (lymphatic cirrhosis) the stage of nodulation does not cause any serious disturbance of health as long as the individual remains free from infection. His bronchitis has, by this time, led to emphysema of the lungs and the right heart will probably feel some embarrassment under exertion, but becoming adapted to a lowered exercise tolerance, he remains, as a rule, hale and hearty until the evil day when infection brings him down.

In conclusion, pneumonoconiosis is a complicated process of great chronicity, subject to wide variations and open to many complications. In its incipient form it is extremely common, perhaps second only to arteriosclerosis. In the form recognized as miners' phthisis or silicosis the characteristic feature is fibrous induration of the lung which partakes of three distinct qualities, namely: 1. organization of inflammatory exudate within the air sacs; 2. thickening of the interstitial framework of the lung, "lymphatic cirrhosis"; and 3. fibrous nodules, a more or less specific lesion directly or indirectly related to the inhalation of stone dust.

Pneumonoconiosis in its uncomplicated form practically never incapacitates the subject. It is super-added infection, either non-specific or tuberculous, which produces the excessive morbidity and mortality in the dusty industries.

Occasionally one hears of cases of acute silicosis. Such cases of this sort as have come to autopsy proved to be complicated by obvious tuberculosis and therefore cannot be regarded as exceptions to the general rule that uncomplicated pneumonoconiosis is an extremely chronic disease.

Pulmonary tuberculosis when complicated by pneumonoconiosis runs on a typical course. Frequently there is no fever, no night sweats, no loss of weight and the sputum may remain persistently negative. It is therefore

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4 E. H. Kettle (Jour. Path. and Bact. 1934, 38, 201). Dr. King of Dr. Banting's department left recently to join Dr. Kettle's staff in London, England, where further important work on experimental silicosis is in progress.

very difficult, as a rule, so the clinical people tell us, to determine when a case of silicosis has become infected.

The material upon which the foregoing generalisations are based consists now of about sixty specimens of lungs from as many cases of pneumonoconiosis arising in various industries, but chiefly in the mines of Northern Ontario. These specimens have been submitted to Prof. Klotz and myself for examination and I am indebted to him for the benefit of his wide experience. A large number of the specimens have reached us through the kindness of Dr. Cunningham and Dr. Riddell of the Ontario Department of Health.

THE CARE OF LIFE*

THE LATE IRA A. McKAY, M.A., LL.B., Ph.D., LL.D.,
Formerly Dean of the Faculty of Arts, McGill University, Montreal.

It is a very great pleasure for me to meet this Association of Nurses again. I remember distinctly your last visit to Montreal and I know that, if you return to that city next year or at any future time, you will receive a greater and more kindly welcome than ever before.

I fear, however, that I cannot say much to you this evening with any great confidence. I confess that my belief in the value of the spoken word has declined greatly in recent years. One often feels, I suspect, in the mood which Phocion felt when he exclaimed: "What have I now said amiss?" when the multitude applauded him. We seem to be living in a world of futile words. Loose talking upon subjects of great interest and importance is undoubtedly one of the greatest dangers in our day. Loose talking about war, for example, is probably the surest way of making war itself inevitable. No real peace is possible where there is no peace of mind. It is the images in our minds and the words of our mouths that control the course of our lives. It does not seem to matter whether the ideas in our minds be good or bad; we are condemned to follow them and become like them. The law of ideomotor action is inevitable. It is only by controling the ideas in our minds that we can control our lives. "As a man thinketh in his heart so is he."

If, to follow my example a little further, we could only think less and talk less about the tragic horrors of war and more about the infinite promises and blessings of peace, I am sure that many of our most dangerous problems would soon begin to solve themselves: competition in homocidal armaments would soon begin to cease its fury; national economic armament by excessive tariffs, quotas, embargoes and other restrictions on trade would soon begin to crumble; the conduits of helpful commerce would begin to lift their gates; the wheels of beneficent industry to turn again and the unwilling unemployed to find the work they need and must have if their lives are not to be wholly lost both in body and mind.

I confess that I sometimes wish, figuratively at least, that the unlicensed public platform and printing press had never been invented. There must, after all is said, be some limit to the right of free public address. I have clearly no right, for example, to address any assembly of people falsely, misleading or negligently, not caring whether my words be true or false.

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*An address delivered before the Canadian Nurses Association, at the General Meeting, in Toronto, June 27, 1934. Reprinted from The Canadian Nurse, Oct., 1934, by permission of the editor.

The only possible use of language is to influence the lives of other people for good or ill. If, for example, the lectures which I offer to University students throughout the term do not help them to lead better lives, then all my work is vain and futile and if by any chance these lectures should lead them into a worse way of life then it were better if I had never been born. I have known the lives of good men to be spoiled by a single malicious adjective and the lives of bad men to be praised beyond the limits of true human greatness.

Language is the instrument by which men communicate ideas, sentiments and emotions from one life to another life and must never be used lightly, and if, therefore, we are willing to hand over this instrument, at once so powerful and so delicate, into the hands of haranguing dictators and demagogues, what do you think is likely to become of our civilization? We seem to have come to a vast human parting of the ways. May heaven send us men of experience, men of true knowledge and sound learning, men of probity and prayer, haloed men, Christlike men to guide us from now on! It was, at any rate, when such rambling thoughts as these were running through my mind that I received your kind invitation to be present this evening, and I then ran over the usual index of subjects and they all looked so weary and worn and battered that I threw them aside and wrote down the subject which appears on your agenda this evening: The Care of Life.

I like this subject: The Care of Life. The little serious thought which it contains is my gift to you this evening in return for your kindness to me. Further than this, however, I should prefer that you think it through each in relation to her own life, for if you fail to do this all my words will be lost. I am speaking to you now as individuals and not as an association.

The longer I live the more intimate and personal my philosophy of life becomes. Indeed, I am not sure that I am not a pure individualist. My colleagues and friends, the economists, sociologists and anthropologists must, therefore, forgive me if I tell them again that they seem to me to be placing far too much emphasis at the present time upon what they call collective life or collective human action. I remind them that collective action is a very dangerous agency. Crowds are always difficult to direct and only men of the greatest courage, true knowledge and fineness can control them. The principal results of collective action hitherto have been wars, revolutions, monopolies, strikes and all sorts of factions. Collective action, in other words, may lead to tribalism and not to peace and good will among men, and I must confess that it seems to me to be travelling speedily in that direction at present.

Let us not forget, then, that the springs and sources of real life are always individual. May I, for example, make my meaning clear from a crude maxim in public finance thus: "All public debts must be paid from private pockets." I wonder how many of the elected and electors in our communities fully realize the hard truth of that maxim! All public, social obligations, in other words, are only another name for those obligations which the individual owes to the community, each in his own way. As William James points out in one of his admirable essays: "Irreducible pluralism is the basic fact of human society. All conscious life is personal. Your consciousness is yours and mine is mine. There is no consciousness, for example, anywhere in this room which is nobody's consciousness." There is no duty in all the world which is nobody's duty.

When I look around me this evening, for example, to find that Goddess of Light and Mercy with a silver crown upon her head, called the Canadian Nurses' Association, she fails completely to appear and I find only you and me. No matter what science, philosophy or political theory may think, the per-

formance of every duty must begin here, now, and nowhere else. "Do the duty, then, which lies nearest thee and thy next duty will then have become clearer!" This is the supreme law of life, the imperative first principle of all human behaviour. As it is written in The Everlasting Yea, "The situation that has not its Duty, its Ideal, was never yet occupied by man. Yes, here in this poor, miserable, hampered, despicable actual wherein thou even now standest (or sittest), here or nowhere is thy ideal: work it out therefrom and working, believe, live, be free" When I speak, therefore, of the Care of Life, I do not mean the Care of Life in the mass or in the abstract, for these phases have no meaning for me. I mean the care of real individual lives in body and mind, in sickness and in health, the Care of Life by you and me, curative, preventive, beneficent.

There is one problem in the philosophy of life which has perplexed all thoughtful minds in the past—the problem of Mind and Body. The most primitive tribes and the most learned scientists have been puzzled by this dualism. Traces of it are found in the ritual and literature of all human history. We seem always to be living in two worlds, a world of physical material facts and a world of mental conscious facts, and these two worlds have nothing in common. No one can explain, for example, how a physical stimulus or a bodily process in the brain or nervous system can become a conscious mental process or how a mental process, a sensation, a memory, or an emotion can affect the bodily organism. The anatomists and physiologists cannot solve this problem because they do not know, they do not even pretend to know how this bodily organism became sensitive and becoming sensitive, became consciously aware of the world of nature around us.

The curious fact is that we can only know things by becoming conscious of them. If I were not conscious of things I would not know anything at all and in some sense, therefore, my consciousness is as vast as the universe. My conscious mind is not, as some would have us believe, a mere speck on the surface of the earth planet. Magnify the physical universe as much as you will, make it billions of light years in magnitude, and you are only paying an implied tribute to this little conscious mind which can say, Oh, boundless wonderful world.

Our conscious bodily senses are the most wonderful things we know anything about. Consider, for exemaple, the human skin, the most modest of the senses, with its sensations of pressure and strain, warmth, cold and pain, and all that these sensations mean to life. Structurally, the skin as you know is a layer or really six or seven layers of integumentary tissue which cover the outside of the body of which the inner layers are living sensitive cells and the outer layers dead and dying cells. All the issues of life and death lie hidden there. Strange things, then, go on under this outermost wrappage of the human body. Or consider again what it means when I grasp you by the hand in love or hate and know that two conscious souls have met here—now on the way to eternity. Consider and bow the head.

Many physiologists and some psychologists, the behaviourists for example, despairing of finding any satisfactory solution to this problem, have attempted to solve it by ignoring or denying altogether the existence of consciousness. Consciousness, they say, is a superstition, a momentary shadow of reality, or, as Huxley said, it is like the smoke from an engine or the steam from a kettle which soon fades away. A recent critic of the behaviourists has said of them: "Psychology first lost its soul, then it lost its mind and now it is losing consciousness," and while this saying is no doubt meant in humour, it seems to me to be quite true. Clearly, we cannot solve the problem in this way We cannot turn off the light and not live in darkness.

Puzzling, however, as this problem is in theory, we need only look at the facts again with an unflinching eye to recognize that the oneness of mind and body is an obvious fact in every moment of our lives. Whatever affects the body affects the mind sooner or later and whatever affects the mind affects the body immediately. Even so simple an act as turning my head or shifting my attention changes my pathway of life appreciably both in body and mind. Just, it seems, as two organs in the body often perform entirely different and opposite functions, so both mind and body play their parts in the life of all individual human beings. The complementariness seems complete and, therefore, both mind and body must be equally respected in the care of life. I commend this truth to you in the practice of your profession.

I do not wish you to think this evening, however, that your profession has any monopoly in the care of life. Education is also interested in this subject and I insist upon sharing it with you. Indeed education fully understood is only another name for the beneficent care of life in body and mind, especially during that earlier period in the life of all known living things, the period of growth from birth to maturity. Too much learning and too much sport are alike unhealthy and dangerous to life. Too much learning maketh Jack a dull boy and mental cases are far too frequent in this class. On the other hand the aim of playing games is neither to win or to lose but to play. The play's the thing. Play all the games and play them poorly is the best sports maxim I know.

We must, however, be careful of our definitions. By education we usually mean the enlargement of true knowledge in the community and the careful training of the students' mental powers of perception, memory and reasoned discourse. At any rate I think that you will agree with me that this is the idea of education upon which we proceed in practice. Why, then, I ask now, this emphasis upon the mind in this narrow sense of the term at the expense of the moral, aesthetc and religious factors which are always uppermost in human lives? Too much knowledge, however true, may be as great a burden on human life as too great worldly possessions—and I am convinced that this is the real reason why so many of our students so soon unburden themselves of nearly all that they have learned in school and college—and the training of the mind in this narrow sense can only produce at its best a type of nude realism clothed in clever literary wit which is all too common in recent literature. Sinclair Lewis, for example, in his late book, "Ann Vickers," aptly describes his own contribution to literature as "corn-beef hash" and this is no doubt true, but the real trouble is that Mr. Lewis, like so many of his contemporaries, does not seem to realize that the hash is mostly rotten.

Is it not clear at once that the training of the mind in this purely scientific and logical sense is almost wholly implemental? As John Dewey insists so constantly, all knowledge, however pure, is merely instrumental. It is not the knowledge of truth, in other words, but the being truthful that really counts and until we make the truth we learn real in our own lives there is no gain. I repeat it again, unless our teaching helps our students to live better lives, all our work is vain and futile. Unless the truths we teach take root in the deeper incentives of life no new life will come.

I am always bewildered by some popular writers and lecturers on science, always untrue to their own subject, who claim with so much confidence that science is only interested in discovery and not in the consequences or human uses of its discoveries; that, for example, it does not matter to the scientific worker whether he discover insulin, some other agent meant to save life or a poison gas meant to destroy it. Is, then, the scientific worker in his laboratory an amoral being? Is he above

good and evil, or is he only like the investment banker caught in the Frankenstein of his own devices, not knowing how to escape? Have science, mechanical invention and industry conspired to ignore the postulates of right living? When was it then, I ask, that the cardinal goods, truthfulness, honesty, work well done, cleanliness and kindness became unworthy of careful study in the schools and colleges? Are not the ingredients of the good life as worthy of careful study as the ingredients of gunpowder? Has the attempt to construe the humanities after the analogy and method of the physical sciences proved a dismal and dangerous failure? Is that the huge mistake we are making?

Economics, for exemple, is obviously a pure humanity. Economics is the study of wealth and the essence of wealth is its human utility and value and not its mere physical existence. If economic commodities were merely physical objects to be produced, moved about and stored in space, the study of economics would have no meaning. If gold were money then money would have no meaning. It is, I think, an obvious scientific fact that all human values fall within the fields of morals, aesthetics and religion. Of what avail, then, that we try to adjust hours of labour, wages, output, prices and profits unless the attempt be based upon some established, true philosophy of human values? Are we trying to devise economic controls when the only effective controls are moral controls? These are vast questions, but we must answer them soon or danger and death are at the gate and will come in. Every scientific discovery and every business transaction is a moral deed and is, therefore, made up from exactly the same elements as private deeds. The real fallacy seems to be that when science enters the field of the humanities, it leaves its own proper field. It leaves, in other words, the field of understanding and enters the field of appreciation and appreciation is always something greater and better than understanding. Open Aristotle and Plato, read "The Republic" and "The Nachomachean Ethics" again and learn and lay to heart that all science, economics and politics are only means which make the good life possible.

I almost hesitate to speak to you about the importance of aesthetics in the Care of Life, since the intuition of beauty is usually supposed to be reserved for only a few fine souls in this hard world. If we only look about us, however, and try to estimate the amount of effort and money which we spend so anxiously and blindly in the attempt to beautify our public places, public buildings, homes and persons we may perhaps be driven to the conclusion that the only thing which men really do desire most in their downmost heart is pure loveliness.

But you will ask what we can do to encourage aesthetic education in this cold, rugged wilderness called Canada. Europe has her music, art and literature and her noble ruins so redolent of human memories, but what have we instead? The answer to this question is that we have all the best that Europe has to offer and a new, clean, vast country all our own.

Talk not to me of summer lands and sunny skies,
Where wild flowers grow in murky meadows by the sea!
I hate the heat and filth and stench and sickening smells
Of all things tropical in hue.
Commend me to the Northern lands and wintry climes,
Where crystal snowflakes sparkle in the air
And white-robed angels flit across the plains
And dance along the starry heavens o'night.
There I shall sing my clear-voiced winter's song
Beneath the great dome's clear eternal day,
Where God's pure countenance shines with a clear, cold light
Unknown to men in other lands than mine.
Then lay me low at last in some wintry place

And wrap my worn-out body in a snowy wreath
And bid my soul be gone on its lone way.
To dwell among the Northern stars forever more.

I know this country from sea to sea: the Maritime Provinces by the sea, the loveliest part of Canada, down the two middle provinces by the wide, rushing river, across the wide prairie lands, "the land for which the tongue of England hath no name," The Prairies, over the giant multitudinous Rockies, gazing like hooded clansmen far across the wide Pacific—I see it all It stands before me now and it is the great health and cleanliness of it all which has always appealed to me most. Healthy, clean bodies and healthy, clean minds must always be our ideal in this new land.

The first duty of every government is to maintain the health of its people; the next duty the education of its people; the next the administration of justice in its Courts of Law; the next the practice of honesty and truthfulness and the performance of all promises in public affairs; the next the practice of good manners, that finest expression of the cultivated mind in all public offices. Let any nation follow these postulates of good government and it need not fear from extreme Fascism or extreme Communism or from any other danger coming from within.

I have no title to say anything to you about religion and the Care of Life, but I cannot finish my story without trespassing a little bit on this subject. I wish to point out to you, then, that what I have said about science is also true of aesthetics. It is not the knowledge of truth and the intuition of beauty which really count. I repeat, unless we make both truth and beauty real in our own lives, there is no gain. This is the meaning of the good life, the only thing in all the world which makes the care of life worthwhile. He would surely be a craven soul, however, who, having enjoyed these priceless revelations, should still forget those attitudes of gratitude, confidence and worship towards that spiritual unity of all truth and beauty immanent in the world of nature around us and implied in all we know or can know. Truth, beauty and goodness all lead by the shortest lines into the presence of God Himself, the fountain and source of all life This is the true meaning of religion.

The sun, the moon, the stars, the seas, the hills and the plains
Are not these, O Soul, the vision of Him who reigns?
And "Is not the Vision He" who can also say "I am I?"

Tennyson misnamed this poem "The Higher Pantheism." He should have called it "The Higher Humanism."

Now I have only a little time left to talk to you in a professional way. I took this subject, The Care of Life, from your profession and now I give it back to you again, I hope with a larger meaning. I shall not flatter you. I know the drudgery and often ingratitude which attends the daily practice of your profession. I remind you, however, that drudgery and sometimes ingratitude are the best human measures of work well done in all vocations in life. It is your work by strong and gentle hands to lift those who are ill in body and mind back to health and strength again, or perhaps to stand by the portals at the great dawn and bid them a fond farewell as they venture forth into the greater life beyond. Do not think that the art of gentleness has no technique, for it is really the most difficult of all human arts to master. Never take a derisive or bitter attitude towards anything in life. Be kind in all things, great and small. There is a law which is higher than the law of justice: it is the law of kindness. Justice gives to each man his rights and no more, but the law of kindness is beneficent and god-like. I once had a friend, very dear to me, who sang and hummed a simple song thus:

If we err in human blindness, and forget
that we are dust,
If we miss the law of kindness in the strug-
gle to be just.

And the refrain of this simple song, "If we miss the law of kindness in the struggle to be just" has been echoing in my ears all these years and I know that it has made a very different man of me.

Two things are necessary in the treatment of patients, their cure and their care. The cure of patients is the task of the medical profession and their care the task of your profession, and I do not know which is the nobler. The medical profession is chiefly interested in the cure of the body, but the oneness of mind and body must always be the first axiom in your profession. It is no doubt necessary, therefore, that you learn all you can about the science and practice of medicine and surgery, but I see a far greater opportunity than that for the education of the nursing profession engaged as you are in the care of life in all its phases. Indeed, there is nothing that is finest and best in the most liberal education that should not be of the greatest value to you in all your work and, if you follow this suggestion, I know that your profession will continue to grow in importance in the future and you will then be needed not only in the hospitals and in the homes, but in the schools and industries and public services and whereever the care of life is needed. And if cruel and deadly war be thrust upon us you will be there, too, to prove by your presence and devotion that after all life is worth living and caring for even in extremis. God bless you and keep you and prosper your Association.

NOTES ON JOHN HUNTER

GORDON S. FOULDS, F.R.C.S. (C.)

John Hunter was a descendant of an old Scotch family of Norman origin, the Hunters of Hunterston in Ayershire, whose history dates back to the Thirteenth Century. The Hunters of Long Calderwood in Lanarkshire, a few miles from Glasgow, belonged to a younger branch of the family. It was at Long Calderwood on February 13, 1728, that John Hunter, the youngest of a family of ten, was born. Although the parish register gives the date of his birth as February 13, he himself always celebrated February 14th as his birthday, and it is on this day that the Hunterian oration is delivered annually at the Royal College of Surgeons in London. Hunter's father was a farmer who owned a small estate, and his mother was a daughter of Mr. Paul, a maltster and the treasurer of the City of Glasgow, "a woman of great worth and considerable talents."

Of his brothers and sisters it is worthy of note that James, the oldest, was educated for law but was attracted by the progress of the younger brother, William, and studied anatomy and medicine in London with him and showed great promise. Due to hemorrhage from the lung, however, he was obliged to give up his associations in London and return to Long Calderwood where he died at the age of thirty years. A sister, Dorothea, married the Rev. James Baillie and became the mother of the famous London physician, Matthew Baillie. William Hunter, who was ten years older than John, was a diligent student and at first studied for the Church, but on account of his friendship with Cullen he changed his mind and became associated with

him. He studied anatomy with the Munros in Edinburgh, and later, in 1741, went to London where he became associated with a Dr. Douglas as Surgeon's pupil at St. George's. In 1746, he commenced his lectures on Anatomy in London. This was a particularly opportune time, as only one year previously the Surgeons had separated from the Barbers and the study of anatomy was thus removed from the limiting control of the Barber Surgeons Company.

Throughout boyhood John Hunter was fond of games and out-of-door sports and was very observant of nature, but deficient in self-control and inattentive to studies. He once said. "When I was a boy I wanted to know all about the clouds and the grasses, and why the leaves changed color in the Aumumn; I watched the ants, bees, birds, tadpoles and caddis worms; I pestered people with questions about what nobody knew or cared anything about."

When seventeen years old John Hunter went to Glasgow where he remained three years helping his brother-in-law who had a lumber yard and cabinet making business in that city. About the end of this period he developed a desire to follow in his brother's footsteps and accordingly wrote to his brother William asking permission to work with him, or as an alternative he proposed enlistment in the Army. In September, 1748, at the age of twenty he joined his brother William in London. He displayed skill and industry in the dissecting room and the following summer became a pupil of Cheseldon, one of the most celebrated surgeons of his day. He continued his studies with Cheselden during the summers of 1749 and 1750, and with the latter's retirement he became a pupil of Percival Potts in 1751. This was five years before the latter fractured his leg.

William Hunter was at all times solicitous of his brother's welfare, and by this time he is said "to have made a man of him but not yet succeeded in making a gentleman of him." In 1753, largely due to his brother's influence, Hunter registered in St. Mary's Hall, Oxford, but his sojourn there was short. Of this experience he later said, "They wanted to make an old woman of me, and that I should stuff Latin and Greek at the University; but these schemes I cracked like so many vermin as they came before me."

On returning to "Town" Hunter continued his anatomical study and research and entered as a surgeon's pupil at St. George's Hospital. This afforded the best opportunities later for appointment on the staff. Two years later he became resident surgeon. It was while holding this position that he discovered the connection between the uterus and the placenta, a discovery which later gave rise to controversy and estangement between the two brothers. In 1758, he undertook experiments on the absorbative power of veins and as a result discovered the function of the lymphatics.

In 1759, following an attack of "inflammation of the lungs" Hunter decided to leave London. He obtained an appointment in a military expedition to Belle Isle and remained abroad until 1763. From the time of his return we may date the beginning of his professional career. Hunter's advancement as a surgeon was slow; this was probably due in a large part to his own disregard for fortune. He was often heard to remark to his friend Mr. Lynn as he laid down his anatomical instruments to answer a professional call—"Well, Lynn, I must go and earn this damned guinea or I shall be sure to want it tomorrow." During these lean years he was continuing his anatomical collection and delivering lectures on anatomy, all his spare money being spent on his collection. As many of his experiments and observations could not be carried out in the city he bought a small place called Earl's Court at Brompton. Here he spent a good deal of his time among a collec-

tion of strange animals from all over the globe. Here it was he pastured those buffaloes which he, as late as 1792, put into harness and trotted through the streets of London. Among other animals he is said to have kept "fowls, ducks, geese, pigeons, rabbits and pigs, and made experiments on them, also opossums, hedgehogs and rare animals,—a jackal, a zebra, an ostrich, buffaloes and even leopards; also dormice, bats, snakes and birds of prey." The story is told that while playfully wrestling with a young bull, a present of the Queen, he was thrown and would have been injured except for the intervention of a servant. Also, it is said that the leopards got loose one day and hearing a commotion in the yard, he went out and though unarmed, captured the leopards and returned them to their cages. Then realizing the danger he had been exposed to, he entered the house and fainted.

In 1767, he was elected a Fellow of the Royal Society and the following year became Surgeon of St. George's Hospital. During these years he resided in a modest house in Golden Square, but in 1770 when William Hunter removed from his place in Jermyn Street to Great Windmill Street, John Hunter took over his brother's former house. While here he had as house pupils, among others, Dr. Jenner and Dr. Physic, later of Philadelphia. Jenner always remained a very close friend and their correspondence in itself is an interesting study. In 1771, Hunter published his first "Treatise on the Teeth."

About this time he married Miss Home, a daughter of Mr. Home of Burgoyne's Regiment of Horse, a woman of no fortune but fond of gay society. Their difference of temperament occasionally gave rise to difficulty. It is said that one evening on returning home tired he found his drawing room full of gay company and being irritated walked straight into the room and addressed his wife's guests as follows: "I knew nothing of this kick-up and I ought to have been informed of it beforehand; but as I am now returned home to study I hope the present company will retire."

From 1773 on, his professional practice grew rapidly, as he was an untiring worker. He arose early and managed to do three or four hours work in his dissecting room before breakfast at nine o'clock; from then until eleven o'clock he saw patients at his house. At eleven, even though others waited to see him he started on his round of calls and consultations, as he said he had no right to waste the valuable time of busy practitioners by being late for appointments. Anything which prevented absolute punctuality irritated him exceedingly.

In 1776 he was appointed Surgeon Extraordinary to the King. In this same year he suffered his first attack of angina pectoris which was diagnosed by Jenner. In 1779 he presented his paper on the relationship of the pla-

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centa and the uterus before the Royal Society. In the years 1776-1782 he delivered his Croonean lectures on Causes of Motion in Plants and Animals which were not published at this time.

In 1783, finding the Jermyn Street house too small he secured a house in Leicester Square consisting of a house in the Square and property reaching back into Castel Street where another smaller building was located. During the following years he joined the two with a two storey building with the museum above and a lecture room and another room below. The house in the rear was used in connection with the museum for making dissections, preparations and so forth, and that in Leicester Square was used as the family dwelling. In his house the meetings of the "Society for the Promotion of Medical and Chirurgical Knowledge" were held regularly. In 1784-5 his cardiac condition became worse and he spent some time at Tunbridge and Bath. Mr. Home, his brother-in-law, and an old pupil who lived with him carried on his practice. It was on his return from Bath that he ligated the femoral artery for the cure of popliteal aneurism, and formulated the principles of the treatment of aneurism. This operation also gave rise to the name of Hunter's Canal.

In 1786, he became Deputy Surgeon General to the Army, and in the early part of this year published his Treatise on Venereal Disease which remained the standard text of Europe for nearly half a century. Even today his comprehensive chapters on stricture of the urethra compare favorably with any modern work. In 1835, Babington, who was Richard Bright's chemist and the first to call attention to increased urea in the blood in renal disease, says of Hunter's work that it laid the foundation for all subsequent works on diseases of the genito-urinary system. In this work he was the first to suggest the bending of a catheter for use in prostatic enlargement to the shape subsequently called catheter coude. The following year he presented the unique paper, "The Structure and Economy of Whales," to the Royal Society.

In 1783 there occurred the death of the Irish giant Byrne, or O'Brien. Hunter had long been anxious to procure his skeleton. On hearing of his declining health Hunter employed a man to watch and keep track of the giant's whereabouts. O'Brien however, heard of this, and having a horror of dissection left a sum of money with instructions that his body should be carefully guarded until a lead casket be made, and that his corpse should then be sunk at sea. When the death occurred Hunter's man found out the ale house which the guards frequented and bribed them to let him steal the body. Hunter's eagerness, however, was so apparent that the price soared and he eventually paid 500 pounds for the remains which he took away to Earl's Court and there in order to save time and because of fear of detection, separated the flesh from the bones by boiling. This accounts for the browned condition of the skeleton which today is preserved in the museum of the Royal College of Surgeons.

In 1785 Home became his assistant at St. George's. About that time Hunter sat for his portrait by Sir Joshua Reynolds. There are two interesting stories regarding this picture. The one referred to by several biographers is that when the picture was about half done Hunter, who had been restive in his sittings, fell into a thoughtful attitude and Sir Joshua, noting this, turned the canvas upside down and painted the head between the legs of the original and later produced the splendid picture which hangs in the Hall of the Royal College of Surgeons. The reproduction of Sharpe's engraving of this portrait is familiar to everyone. Another story of the picture told by Sir Arthur Keith, now curator of the Museum of the Royal College of Surgeons, is that Hunter

had a small scattered beard, as appears in a rough picture of him hung in Apothecaries Hall and said to be from the brush of Reynolds, and the story goes that Reynolds objected to the beard and had a *plaster* mask made from which he painted the now famous portrait. At any rate a mask of Hunter's face still exists.

Hunter's health, which had been precarious since 1785 became much worse in 1789. However, he continued unceasingly in his work, both at Earl's Court and in Town. In 1792 his friend Joshua Reynolds died and he, with Sir George Baker and Mr. Home, who had shared the care of Reynolds in his last illness, conducted a postmortem and found a markedly large liver of the cirrhotic type, weighing eleven pounds. He resigned from lecturing, which was taken up by Mr. Home. About this time he entered a controversy with the other surgeons of St. George's Hospipta regarding teaching methods of that day. This was followed by a further controversy over the admission of pupils, and while at a board meeting one of his colleagues flatly contradicted him. He got up and left the room and fell dead in the outer room from an attack of angina pectoris. His death occurred on October 16th, 1793, the day of the execution of Marie Antoinette in Paris. He had often said that his life was in the hands of any rascal who chose to make him mad.

It is estimated that he had personally dissected 315 different species of animals. His museums consisted of 13,672 specimens and cost him 70,000 pounds. This was eventually sold to the British Government for 15,000 pounds and is in the custody of the Royal College of Surgeons.

To say that he was the father of scientific surgery is inadequate. He was also the founder of scientific zoology and comparative physiology. He was the Newton of the medical profession and what Pope said of Newton may by paraphrase be said of Hunter with equal truth and force:

> "Nature and Nature's laws lay hid in night,
> God said, 'Let Hunter be', and all was light."

Though he was first buried in St. Martins in the Fields, his body was disinterred and reburied in Westminster Abbey in 1859. It may well be said that he is one of

> "The immortal dead,
> Who rule us from their urns."

Note:—Much of the above material was obtained from "John Hunter, Man of Science and Surgery, 1728-1793." — Stephen Paget, New York, Longman, Green & Co., 1898.

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BONE REPAIR AND THE FACTORS INVOLVED

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The repair of bone seems a simple problem to those whose knowledge of the matter is slight; it is a most confusing problem to those whose knowledge only extends to realising that there are several fundamentally different accounts of the process, and it is an aggravating problem to those whose knowledge is fairly comprehensive. This article will in all probability confuse those of group one but it is hoped that it will help those of group two and lift them to group three, where they may experience aggravation rather than confusion.

It is common knowledge that there forms at and about a site of fracture a new mass of tissue which is known as a callus. This does not form immediately after the break in the bone but develops day by day from about the second day onward. The tissue making up the callus, providing the repair is successful, is of a bony character, although certain amounts of cartillage may be present during the early phases of repair. This article is concerned with the source and reason for the occurrence of this tissue of the callus.

It is convenient first to decide whether heredity or environment of cells is responsible for the formation of the bone of the callus. The older view postulated that certain cells of bone or periosteum possesses a specific inherent ability to produce bone and that this ability is not common to other types of cells which are specialized to do something else. A newer view, although not original in all its aspects, has recently been widely championed by Leriche and Policard. It postulates that the environment of a broken bone is the most important factor in the formation of callus, that the calcium surcharge from the dead fractured ends of bone is of great importance in bringing about the formation of what they term an "ossifiable medium," the creation of which is not dependent upon the action of specific cells such as osteoblasts. Thus they think the environment of a broken bone is the important factor in repair and that specific cells for bone formation are not at all important.

In any attempt to decide which is the more important, heredity or environment, it must be admitted that there are findings which indicate without a doubt that environment plays a definite part in encouraging bone formation. The one important environmental factor which is known to encourage bone formation is the calcium salt deposit. It has been known for a long time that bone was prone to occur beside a calcified area in the wall of an artery, in the tonsil or in an old tuberculous lesion. These findings, however, do not prove that a calcium deposit can always induce bone formation, indeed experimental results indicate the contrary Rhode transplanted pieces of dead bone into various soft tissues of the experimental animal and was unable to show that the dead bone induced bone formation in any of the locations in which he planted it. The author placed various amounts of sterile calcium phosphate and carbonate in the soft tissues of rabbits and was unable to demontrate bone formation in any of the locations in which they were placed. Thus, although there is the occasional example to indicate that calcium salts can induce bone formation in ordinary connective tissue, there is no evidence for Leriche and Policard's sweeping generalizations about the importance of the calcium surcharge in bone formation.

When bone develops in areas not commonly given to bone formation,

the problem concerning the origin of the cell which gives rise to the bone is immediately raised. There are two explanations for its origin. The first depends on the hypothesis which postulates that there are present throughout the soft tissues of the body, mesenchymal cells which have never exploited their potentiality, in other words, embryonic connective tissue cells. These cells could readily respond to a calcium stimulus to differentiate along the bone pathway. Those who are cautious about accepting the hypothesis concerning the presence of undifferentiated mesenchymal cells in the soft tissues propose that fibroblasts are the source of the bone, and suggest that fibroblasts readily undergo a de-differentiation, thus becoming like embryonic connective tissue cells and able to respond to the calcium stimulus and differentiate along the bone pathway. The first explanation seems to offer fewer objections than the second. Either explanation would be in accord with Adami's conception of metaplasia, so that the formation of bone in soft tissues far removed from the skeleton can safely be considered as an example of metaplasia.

It therefore seems quite clear that calcium deposits, on occasion, stimulate bone formation in soft tissues, and so it may be concluded that one environmental factor at least is of definite importance in the production of bone. It is, however, a long step from this conclusion to the one which says that environmental factors are all important. It has been suggested above that certain cells of considerable potentiality must be present to respond to the calcium stimulus. It has not been proven that fibroblasts can readily respond to this stimulus. Consequently, although there is evidence that environmental factors are of some importance in the production of bone, there is no indication that they are of as great importance in bone repair as the availability of certain of the cells which exist in and around bone and which will next be discussed. It seems better to reduce the discussion to cells rather than layers of tissue in order to escape entering into the controversy which is now almost two hundred years old, namely, whether bone is repaired from the bone or the periosteum. The periosteum versus bone controversy is a difficult one to discuss because different people understand different things by periosteum or bone. The anatomical definition of the periosteum postulates it to have an outer fibrous part and an inner osteogenic part. As it was found, however, that only the fibrous part comes away in its entirety when periosteum is stripped, a surgical conception of the periosteum developed which included only the fibrous portion of the anatomist's periosteum. Furthermore, many authors are not clear about what they mean by bone. They speak of repair ensuing from bone but leave one in the dark as to whether they consider the term bone to include either periosteum or endosteum or both. The whole problem is on a much sounder foundation if the various cell types are considered. Even then great care must be used because there are great discrepancies in the terminology. Consequently that used in this paper will be carefully explained as each possible cellular participant in the repair process is considered below. There are:

1. Adult bone cells (osteocytes) which live in lacunae and are completely surrounded by calcified bone matrix, which is a special substance possessing a profound affinity for calcium salts.

2. The lining cells of bone (osteogenic cells and osteoblasts). These cells make up the deep layer of the periosteum (or what some call the osteogenic layer of the cortex) which covers the exterior of a bone, and the endosteum which lines both the medullary cavity and the Haversian canals of the bone. (Osteogenic cells are not quite the same as osteoblasts, as they are relatively undifferentiated, almost embryonic-like cells which

have great potentiality for growth and development. Osteoblasts are a step further along the pathway of differentiation into young bone cells and hence are more specialized and possess less potentiality than osteogenic cells. The living cells of bone may be either osteogenic cells or osteoblasts as well as any stage between the two. For a full discussion of the reasons for the selection of these terms see Ham, 1930, 1932).

3 The fibroblasts of the fibrous portion of the periosteum and the fibroblasts which lie outside the periosteum.

4. The embryonic reticular (undifferentiated mesenchymal) cells of the bone marrow.

The easiest and most efficient way to study the capacity of these various cells for regeneration is to follow their behaviour in fractures which have been allowed to heal for various lengths of time. Preparations of this nature may be obtained readily from the experimental animal.

1. The behaviour of the adult bone cells following a fracture. An examination of the adult bone situated near the line of fracture shows as soon as two days that many have suffered death. By ten days the picture is much clearer and it is then obvious that practically all the lacunae in this area which formerly contained healthy bone cells, are now empty save for the pyknotic remains of their former residents. The bone cells situated a few millimeters away from the line of fracture show no evidence of cell division, so there is no evidence whatever from a histological examination of fracture material to indicate that the mature bone cells play any significant part in the process of bone repair.

2. The behaviour of the lining cells of bone following a fracture. The osteogenic cells and osteoblasts exhibit two different phenomena following a fracture. The first is proliferation (an increase in their number) and the second is differentiation (a specialization of these cells into a more adult type).

If a two-day fracture section is placed under a microscope and the observer examines, for example, the osteogenic cells which cover the bone as the deep layer of the periosteum (or what is also termed the osteogenic layer of the cortex) at a point some distance off from the site of the break, he will see that the osteogenic layer is of one or two cells in thickness. If the observer then moves the slide so that the fracture area comes slowly into view he will see that close, but not in direct contact with the site of fracture, this layer of cells has become much thicker than normal Close inspection will almost invariably show in this area that many mitotic figures are present in the osteogenic cells. Following the picture day by day will reveal that the osteogenic cells continue proliferating and provide the great part of the tissue which forms to repair the break. Repair is accomplished chiefly because a wave of proliferating osteogenic cells sweeps from each fragment over the break and unites with the one from the opposite fragment. The osteogenic cells, however, do more than proliferate. As soon as two days after the fracture, there is evidence to show that at least some of them begin to differentiate. In the area close to the shaft of the bone where capillaries are present, the osteogenic cells turn first into osteoblasts and then into young bone cells, and during this procedure small islands of organic matrix is formed, presumably by the secretory efforts of the osteoblasts. Some of the young bone cells become locked in lacunae in the matrix they are forming. The osteogenic cells in and about the zone between the middle and outer third of the cellular callus do not change directly into osteoblasts and bone cells as do many of the osteogenic cells situated close to the shoft of the bone, but differentiate into chondroblasts and then into adult cartilage cells. There is nothing very surprising in this occurrence as the ancestors of these cells showed ample ability to form cartilage in the

development of bone. In fact osteogenic cells form cartilage so readily, not only in the development and repair of bone but also in osteogenic sarcomata, that one must admit that osteogenic cells possess a capacity to form either bone or cartilage. Which they form may be dependent on environment and there is some evidence to show that vascularity is an important factor in this regard. In the callus it is seen that the osteogenic cells which differentiate into chondroblasts and cartilage cells do so in a zone which is not yet permeated with capillaries. The cartilage which forms lives only a short time and as it calcifies and disintegrates, osteogenic cells and capillaries grow into its remains and in this vascular environment the invading osteogenic cells differentiate into osteoblasts and then into bone cells during which procedure bone matrix is formed. The remnants of cartilage matrix in the callus thus become covered with bone matrix.

After the cartilage is replaced by bone, re-modelling tends to occur. The histological structure of all bone is constantly changing, and the new bone of the callus is no exception. In the process of remodelling new trabeculae are built close to the line of the old bone and the trabeculae situated at the periphery of the callus tend to melt away. Thus the effect of the re-modelling tends more and more to restore the original line of the bone.

3. The behaviour of the fibroblasts of the periosteum following a fracture.

If a single fracture section is examined it is found that on some occasions it is almost impossible to decide upon the source of certain cells and tissues of the callus. The portion which arises from the fibroblasts and the portion which arises from the osteogenic cells can only be determined accurately by studying a series of fractures which show the day-to-day changes. Such a study indicates that the fibroblasts of the fibrous portion of the periosteum do not show the same abilities to make cartilage and bone as the osteogenic cells. A day-to-day study shows that the cartilage and bone of the callus arises from the osteogenic cell proliferation and not from a fibroblastic proliferation. A study of experimental fractures in the author's opinion gives no support for Leriche and Policard's statements regarding the fibroblastic origin of the callus. It should be noted, however, that terminology is sadly inaccurate in this field; even Maximow and Bloom, who are usually meticulous in what they term a fibroblast, designate on occasions cells with bone forming potentialities as fibroblasts. Many writers fail to make any distinction between fibroblasts and osteogenic cells.

There is, of course, other evidence beside that gained from a study of a whole set of healing fractures which supports the conclusion indicating the osteogenic cell's great potentiality for bone formation in contrast to the limited potentiality of the fibroblast. Repair of bone has been found to have been greatly slowed and in some instances inhibited by first removing the whole periosteum (fibroblasts and osteogenic cells). This procedure would not interfere with the formation of callus from fibroblasts situated outside the bone.

A second point of interest in this connection lies in the fact that the sort of tumour which arises from the fibrous portion of the periosteum is different from that which arises from the osteogenic layer. (Ewing). The former forms fibrous tissue and the latter forms osteogenic cells, cartilage and bone. (In some cases osteogenic sacromata also form osteoclasts. This is not remarkable as osteoclasts normally develop from osteogenic cells. When osteogenic sacromata contain many osteoclasts a great deal of care must be used in distinguishing them from benign giant cell tumours of bone).

There is little real evidence to indicate that fibroblasts have the same sort of potentiality to repair bone as that possessed by osteogenic cells.

4. The behaviour of the embryonic reticular (undifferentiated mesenchymal cells) of bone marrow following a fracture.

Most of the bone which forms in the medullary cavity following a fracture may be seen to develop progressively from the endosteum which lines both the marrow cavity and the trabeculae which course through the marrow. Occasionally, however, bone arises from the marrow over a wide area, giving no impression of its formation having been a progressive, layer by layer growth The origin of this bone may be, it is thought, best explained by suggesting that it arises from the undifferentiated mesenchymal cells of the marrow. These cells having great potentiality should be able to respond to the fracture stimulus and form not only new bone, but new marrow as well

Having reviewed some of the evidence which is at present available concerning the various factors involved in bone repair it is now possible to attempt to draw some conclusions regarding their relative importance in the process For the convenience of those who are possibly unfamiliar with some of the newer work regarding the calcification of cartilage and bone, certain observations and conclusions derived from this field of work will also be included in the summary.

Summary.

1. It seems probable that the products of tissue disintegrated from the fracture area are the cause of local and possibly fairly specific cell proliferation in and about the fracture area.

2. It seems probable that the liberation of calcium from the dead ends of fractured bones encourages cells if they are able to differentiate into cartilage and bone cells. It is dubious, however, if much advantage would be gained by placing additional calcium in the fracture area.

3. It seems most probable that this ability to respond to a calcium stimulus is not common to all cells and that osteogenic cells (the lining cells of bone) are specially adapted to differentiate into bone and cartilage.

4. There is evidence to indicate that the vascularity of the environment in which the osteogenic cells differentiate is a determining factor in deciding whether they will form bone or cartilage.

5. There is no good evidence to indicate that fibroblasts can make the specific calcium binding matrix (organic intercellular substance) of cartilage or bone.

6 Although the matrix of bone has a physio-chemical affinity for calcium salts it does not become perfectly calcified unless it contains live cells, because it has been shown that the bone cells, osteoblasts, and old cartilage cells manufacture an enzyme, phosphatase, which splits certain phosphoric esters in the tissue fluid so as to increase the local concentration of phosphate ions, which occurrence would cause additional calcium phosphate precipitation.

7. If the gap between the fragments is not bridged by an osteogenic cell growth in a certain time it seems reasonable to believe that fibroblasts would fill in the gap with fibrous tissue, the matrix of which has no special affinity for calcium salts. Once fibrous tissue fills in the gap it cannot be converted to bone, as no adult tissues can be transformed from one type to another.

8. The manufacture of the organic portion of the intercellular substance (matrix) of bone is dependent on the presence of vitamin C in the diet. (Bone matrix will not form in rats on a vitamin C deficient diet).

9. The calcification of the matrix of the callus is dependent on many factors, the specific character of the matrix, the production of phosphatase by the cells of bone and the concentration of calcium and phosphorus in the tissue fluid which is in turn dependent on a normal parathyroid gland and a normal vitamin D calcium and phosphorus intake.

10. The administration of excessive amounts of parathyroid hormone or vitamin D to a normal individual with a broken bone is more apt to prevent the calcification of the matrix of the callus than to improve it.

A few representative references expressing the various points of view on bone repair are listed below. Most of these articles possess extensive bibliographies:

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FRACTURES OF THE MALAR BONE

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The latest addition to the specialties in the art of medicine is plastic surgery. This specialty includes the transplanting of skin, the repair of superficial deformities, cosmetic surgery, and the surgery of abnormalities of the face. As a result, the fracture problems which fall to the lot of the plastic surgeon are those of the malar, maxilla, and mandible. In this paper discussion is limited to fractures of the malar.

Whilst some authorities, e.g., Hey-Groves, believe that fracture of the malar is unusual, it has not been so in our experience. During the last year and a half nine cases have been treated. Eight of these were recent fractures. There is no particular reason why this fracture should be unusual. The bone is prominently placed. It is by no means particularly strong. However, in most text-books the fracture is dismissed with a few lines, and with no record of the clinical findings.

Anatomy. The malar is an irregularly shaped bone formed by an inner and outer plate. These meet at an angle of 70 degrees. The inner plate forms part of the floor of the orbit, the outer the facial prominence of the malar. A frontal process extends upward to articulate with the frontal bone, and forms part of the lateral orbital margin. A second process extends forward to articulate with the maxilla. This process forms over one-half of the lower orbital margin. Below and lateral to this is the lower or masseteric border which rounds off posteriorly to form a process which articulates with the zygomatic process of the temporal bone. The upper posterior surface of this process forms an attachment for the temporal fascia. Deep to the articulation of the process with the zygoma lies the coronoid process of the mandible.

Aetiology. The fracture is always due to direct violence. In our cases four were due to a fall, four to a blow, and one was the result of a bicycle accident. It occurs much more commonly in men, and usually on the left side. These facts are well illustrated in our series, in which all the fractures oc-

curred in men, and seven of the nine were on the left side.

Varieties. Although the body of the bone is rarely broken, a break through one or more of the processes allows it to be shifted. Both the direction and the degree of force influence the resulting displacement. A direct blow produces a depressed fracture; a blow from an angle produces sliding and tilting of the loosened fragment.

The usual sites of fracture are (1) lower and posterior process articulating with the zygoma, (2) infra-orbital foramen, (3) lateral orbital margin, and (4) the anterior wall of the antrum. Practically any combination may occur.

Signs and Symptoms. Almost all patients seen shortly after the injury which has fractured the malar have a black eye, plus considerable swelling of the malar area. There may or may not be subconjuncival echymosis. If the displacement is great enough movements of the mandible are interfered with. This was present in the 8 early cases. It is due to interference with the movements of the coronoid process of the mandible by the displaced malar. More rarely is the mandible shifted to the normal side. This was noted in 2 cases, and may be an attempt to attain a position of rest as has been suggested, or simply the result of mechanical interference with normal mobility. Since the masseter originates from a portion of the malar, attempts at mastication are painful.

If the fracture has displaced part of the orbital plate downwards a lowering of the eye-ball will be noted. This was seen in 1 of the cases. Should the fracture involve the maxillary portion of the malar, blood will fill the antrum, and result in epistaxis. Unilateral haemorrhage from the nose was noted in 4 cases.

Palpitation of the inferior and lateral orbital margins should always be done in cases of suspected fracture. This procedure alone will suffice to reveal many fractures which otherwise might be missed. Any irregularity of the margin, particularly if tender, should be checked by X-ray plates. Palpation reveals tenderness over the points of fracture, the displacement, but very rarely crepitus.

Numbness will be complained of if the infra-orbital nerve has been interfered with. In 3 cases sensation was diminished over the side of the nose, and along the upper lip on the injured side.

After the swelling disappears a flattening of the side of the face is noted. There is usually also a change of expression on the injured side as a result of this flattening.

To sum up—a typical fracture of the malar will show a black eye, subconjunctival haemorrhage, swelling, unilateral epistaxis, inability to fully open or close the mouth, a shift of the mandible to the normal side, and numbness and diminished sensation over the distribution of the infra-orbital nerve.

Complications. Limitation of movements of the eye, and the development of a suppurating antral haemotoma may result from a fracture of the malar.

Treatment. There are many methods of treatment, but the best would appear to be that of Gillies. Fortunately the fractured malar, once replaced, tends to remain in position.

Manwaring suggested that a pair of cow horn dental forceps be inserted through a small incision and the displaced bone grasped and returned to its normal position. Variations of this manoeuvre have been suggested from time to time. For example, screwing an instrument into the bone through a small incision and then lifting it into position is a time honoured procedure. Or an elevator can be passed deep to the bone through a similar incision and the fragment levered into place. Matas suggested a stout ligature around the malar on a needle and using the ligature for traction. In all these methods a scar is

left on the face, and an opening is made in tissues damaged by the injury which has produced the fracture. Such tissues are more easily infected than healthy ones.

Gillies, in 1927, suggested an ingenious method which appears to be most satisfactory of any. The side of the head above the fracture is shaved and a short incision is made above and in front of the ear This is carried down to the temporal fascia which is split in the direction of its fibres. An elevator is then inserted deep to the fascia, and since the fascia is inserted into the malar and zygoma, must pass deep to the fracture. Appropriate manipulation with the elevator easily returns the bone to its normal position. Gillies claims for this method (1) the resultant scar is negligible and hidden (2) the incision is away from the injured parts, (3) no important structures can possibly be injured, and (4) the necessary force can be applied easily.

An untreated fracture is usually one which has not interfered with mandibular movements and therefore not forced attention. It is thus one in which there has been simply displacement of bone without any noticeable impairment of function. The end result is union in an abnormal position with consequent change in shape of the face. This change varies from flattening of the whole malar area to a pit-like depression of part of the bone and soft tissues. From the point of view of cosmesis, this is a poor result and patients may report for treatment because of their changed facial symmetry.

Deformities resulting from old untreated fractures of the malar may be repaired by a free fat graft, a cartilage graft, or by refracture and returning the fragment to its correct position.

All 8 of the recent cases were treated by the method of Gillies. 7 gave excellent results. The eighth would not stay in the normal position but remained a little depressed. As the patient was a labourer it was not considered justifiable to do anything further to obtain a better cosmetic result.

Conclusion. Fracture of the malar is not a rare occurrence. It produces a definite clinical syndrome, more clear cut than almost any other fracture. The fracture is easily and simply treated as outlined.

An adequate knowledge of the signs and symptoms should make the recognition of malar fracture more frequent and the adequate early treatment of a recent fracture makes for a good cosmetic and functional result.

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THE SURGICAL TREATMENT OF PULMONARY TUBERCULOSIS*

C. H. JAIMET, '36.

Public Health statistics show that although tuberculosis is not the problem to-day that it was several decades ago, it is still responsible for one-seventh of all deaths in the world and has been described as the commonest, most fatal and perhaps the saddest of those diseases which oppress mankind. So, it is fitting that a general discussion should be undertaken in its connection.

For the last forty years, collapse therapy for pulmonary tuberculosis has been known to the medical world. However only within the last 25 years has it been used at all extensively and then mostly in the form of pneumothorax. Thoracoplasty became known to the world 25 years ago and phrenic interruption some 20 years ago. At that time, however, the problem was a different one from that of to-day. As in all diseases where medical treatment is sufficient in one case, but where surgical treatment has proved helpful in others, it has always been radicalism versus conservatism. And so, up until about 5 years ago the problem was:— Shall the patient be submitted to collapse therapy, in whatever form, or left on sanatorium bed treatment? To-day, with the realization that sanatorium treatment cannot possibly be successful in more than 20% of cases at the outside, it is a question of, under the conditions, to what form of collapse therapy shall we submit this patient?

The following discussion enumerates those surgical procedures which have proved most efficient and are in common use to-day. With regard to each, the factors which would indicate the use of the technique under discussion, as well as the factors of contra-indication, the complications and the results one would expect, with only a short note about the technique used will be presented. As regards the latter, we shall consider only the technique which is in practise in the majority of hospitals, not mentioning the modifications used by some.

At this point a note on the pathology would not be out of order, As Corrylos points out, all forms of tuberculosis are not suitable for surgical treatment and in this respect most authors agree with him that a qualitative rather than a quantitative classification of the disease will prove of greatest value. So I shall submit to you that of Ulmar and Dittler. They divide pulmonary tuberculosis into the acute and chronic forms. The acute may be sub-divided into the tubercular pneumonia, when it is lobar in distribution, and tuberculous broncho-pneumonia, when lobular. The chronic may be divided into the benign (resolving forms) and the caseous pneumonic or ulcerative forms. The acute, similarly, may be further divided into the acute exudative resolving form and the productive or non-resolving form. The word resolving as introduced in this classification indicates how important is a knowledge of the form presented by the disease when considering surgical intervention.

Tuberculosis is the great cavity producing disease of the lungs and it is believed by some that cavities of some size are present in whatever form of the disease, whether demonstrable by X-rays or not. This however, if true, could not be applied to adults. As long as a cavity is present, the disease is present, and the sputum positive. Cavitation runs a different course and takes different forms just

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* Paper read before the Alpha Omega Alpha honorary Medical Society.

as the disease itself does. Burrel discusses cavities thus:—They may be divided into 4 types:—

(1) The recent cavity with the necrotic wall and very little, if any, fibrous tissue.

(2) The cavity containing pus with a fibrous wall.

(3) The dry cavity with a fibrotic wall.

(4) The cavity presenting no physical findings, diagnosed only by X-ray, which may take the form of any of the above, into which group fall the largest number of cases and must be treated the same as the others.

Cavities may be single or multiple. They may be in the region of the upper lobe, as a great majority are, or they may be elsewhere in the lung. As is generally known, a cavity does not take one form and maintain that through the course of the disease. It begins as a necrotic area, in which fibrosis takes little or no part, advancing in all probability to one of larger size, with more or less fibrosis. This process continues, if the patient lives, until finally we have a large thick-walled cavity through which may run vascular trabeculae, which are most difficult to close and often cause haemoptysis. Corrylos states that of individuals, with cavities 3 cm. or more in diameter. 60% will be dead within 3 years and of those, with cavities of smaller size 80-90% will be dead within 5 years. For this reason, as well as the fact that these persons are a menace to the community, an attempt must be made to close these cavities. The pleura may or may not be involved and pleural adhesions similarly may or may not be present. These latter conditions are important as they modify our treatment.

Surgical Procedures.

(1) **Pnemothorax.** In this form of treatment air is introduced under low pressure into one pleural cavity, in most cases, or into both, in special instances. This is done under aseptic conditions by means of a large gauge needle, under a local anaesthetic at any safe point in the chest as indicated. It is of special importance that only in rare conditions does this leave the pleural cavity with a positive pressure at the end of this procedure, for, as in all forms collapse therapy, the purpose is to allow the lung to collapse due to its own elasticity and atmospheric pressure in the case of thoracoplasty. Forceful compression, in most instances, results in serious consequences, if not high mortality. Since our purpose is to collapse the lung and so put it to rest, we must continue, at intervals, to refill with air to replace that which is absorbed and study the efficiency of the technique by sputum examination and X-ray.

(2) **Phrenic interruption** and scalenectomy, which are often combined. In this operation the phrenic nerve and the scalenus anticus muscle are exposed near the insertion of the latter. The phrenic nerve may be crushed, in which case temporary paralysis of that half of the diaphram will result for about five months. Or it may be evulsed, in which case it is divided and its perpheral end torn out. Here permanent paralysis results. As many authors point out, a large nerve supply of the diaphragm runs through the accessory phrenic, found among the fibres of the nerve to the subclavius muscle, which must always be divided. In the case of scalenectomy, which is now often done as a part of one of the other procedures, the muscle is simply divided to decrease movement in the apex. Paralysis of the diaphragm is a safe procedure and often, alone, but especially when combined with pneumothorax, permits of markedly decreased movement in the lower lobe, and to a lesser extent in the apex.

(3) **Pneumolysis,** which may be intra-pleural or extra-pleural. The first proceedure involves the coagulation of intrapleural adhesions by electric methods and then their division, by cautery, close to their parietal attachment.

for the purpose of making possible an efficient pneumothorax. The extra pleural operation, referred to in this paper as plombage, consists of a gentle stripping away of the parietal pleura from the endothoracic fascia by means of the finger. It is most frequently done in the apex, where it is referred to as apicolysis. This operation is done through an opening made in the chest wall posteriorly, by the removal of a small piece of the third rib under local anaesthetic. The space thus left, between the collapsed apex and the intact chest wall, must then be filled with material to insure a permanent collapse. The material in common use is malleable paraffin, vioform as an antiseptic and bismuth carbonate to facilitate X-ray pictures if so desired. Several points are of major importance in this operation. (1) collapse must be insured to a level below that of the cavity. (2) not more than 300 c.c. and preferably about 150 c.c. of the material should be used. (3) This material must be placed in loosely in sausage-like rolls, using no pressure to pack it.

(4) **Thoracoplasty.** This is a major surgical operation which involves the removal of from three to eleven ribs and always, in those cases demonstrating apical lesions, includes the first rib. The technique has been subject to many changes within the last few years, and still differs in many hospitals at the present time. Upon several things, however, most authors agree: (1) Where the lesion is so extensive that many ribs must be removed this can only be done, with safety to the patient, in at least two stages. The interval of recovery between them should not be less than three weeks and not more than six weeks. Fixity of the chest will have occurred after this time. No more than four ribs should be removed at one stage. If the above precautions are not observed statistics show that the mortality rises in the better hospitals from a negligible amount up to as high as 40%. (II) The section of rib removed should include the head, if possible, and the transverse process of the vertebra. This should extend as far anteriorly as is necessary to uncover the diseased part without involving too much deformity. (III) The incision is a long one, starting at the level of the second thoracic vertebra, midway between it and the vertebral border of the scapula, which is rotated as far anteriorly out of the way as possible. The incision is carried downwards and laterally, medial to the vertebral border of the scapula, ending at the posterior axillary line at the level of the seventh rib. This permits exposure without undue cutting of the upper end of the trapezius muscle, thereby giving rise to a minimum amount of deformity. Contrary to the beliefs of many, throacoplasty as done now, does not result in great deformity. Scoliosis of the spine does result, but this does not give rise to gross disfiguration in most cases. The chest is obviously flattened, but it is protected by the regenerated ribs. Support can be left for the breast of the female in most cases. The arm is capable of complete active movement.

Complications. Before considering the indications for the above procedures and the results achieved, it is necessary to be acquainted with the complications which may, and often do, arise from them. This is necessary for two reasons; firstly, we must be aware that no one of the proceedures is free of them; so that we may not become too conservative in our treatment, and secondly we must be able to recognize these as complications when they arise. For instance, some authors will enlarge upon the efficiency of pneumothorax and all but discard what they consider too radical a proceedure, namely, thoracoplasty. Still, as will be shown, pneumothorax can, and very often does, give rise to very drastic complications.

These complications then:

(I) *Of pneumothorax.*

(a) Cardiac or vasomotor inhibition as a result of plural shock. (b) Air

embolism. (c) Puncture of the lung, intercostal vessels, some large vessel, or the abdominal cavity. (d) Surgical emphysema, which may be superfiicial or deep into the thoracic fascia or the neck. (e) Pain of all degrees from a sense of tightness to one of excruciating severity. (f) At some time following the operation Pleurisy or pleural effusions may result. The latter varying from small to large amounts of serum or pus. (g) Adhesions too may form necessitating a pneumolysis. (h) A displaced mediastinum with its characteristic. Cardiac symptoms such as dyspnoea, tachycardia, and pain, though rare, has been noticed.

(II) *Of plombage.*

(a) Rupture of the cavity outwards during operation. (b) Effusion into the extrapleural cavity making the plomb inefficient. (c) Erosion of the paraffin into the lung or outwards on to the surface of the body. (d) Lack of formation of a bed for the plomb, with subsequent fall of the paraffin, collapsing good lung.

(III) *Of thoracoplasty.*

(a) Paradoxical breathing. (b) death due to too great a lowering of the vital capacity in a patient improperly judged as being fit for this operation. (c) Infection of the wound.

Indications. We shall now consider the indications for the procedures outlined above. In most cases a choice can be made between thoracoplasty and pneumothorax with or without intrapleural pneumolysis. To say, as some authors do, that pneumothorax should always be tried first and failing should be followed by thoracoplasty cannot be accepted to-day, for many reasons. Apical thoracoplasty has developed into an operation with negligible mortality and a low morbidity. At the same time, we are aware that pneumothorax is not surgically a sound procedure because an open pleural cavity is a potential source of menace and complications. Its indiscriminate usage in the past and its prolonged use without closure of the cavity in many cases, with the loss of valuable time before its limitations were realized, lead us to the conclusion that thoracoplasty is often indicated as the primary rather than the secondary form of treatment.

When, therefore, a patient presents himself, we must take the following facts into consideration before we hesitate to consider a more extensive operation. In 80% of all cases of pulmonary tuberculosis the cavities are located in the apex and thoracoplasty, as will be shown, gives the best results in these. *The persistence of a cavity, regardless of its size, is serious, for as long as the cavity is open and the sputum positive, the patient is doomed.* The terms "arrested disease" and "improved patient" are meaningless so long as the above is true. The large, thick-walled cavities, which do not lend themselves to any but the most drastic procedures, develop from the thin-walled form. Many authors will agree with Corrylos who says, "When reasonably long bed rest has proved that we are dealing with real cavities, and when these are strictly apical lesions, the treatment of choice is only apical thoracoplasty. The same holds true for bi-lateral apical cases." In these cases thoracoplasty gives the greatest percentage of cures in the shortest time. With more extensive lesions pneumothorax, aided by pneumolysis if necessary, is better because of the somewhat greater mortality and frequent deformities with total thoracoplasty. In the latter type, therefore, try pneumothorax first and continue, submitting the patient to thoracoplasty only when this has failed. It is to be remembered, however, that if the pneumothorax does not obliterate the cavity after a reasonable time, thoracoplasty is imperative. The chronic proliferative form of the disease is non-surgical, provided that no cavities are demonstrable. Sputum in these cases is either negative or Gaffky 1-2. The disease is ignored or well tolerated by these patients.

The patients presenting themselves with the chronic malignant form in one lung and the chronic benign on the opposite side, involving only the apical portion, when submitted to thoracoplasty of the more serious lung behave like uni-lateral cases. The acute exudative resolving forms do not require surgery any more than do the productive, for they recover spontaneously in bed as a rule. The surgeon tries, as much as possible, to avoid operating while the disease is manifesting itself in the acute stage. Diagnosis of the form is difficult in the acute stage, but one can suspect the benign exudate form by its lesser toxicity, better general condition, smaller numbers of bacilli in the sputum and fewer stethoscopic signs, considering the radiographic extent of the disease. It is the opposite in the caseous ulcertative form. At any rate, within 5 to 15 weeks diagnosis becomes easy, since now the benign form shows a more or less advanced resolution, whereas a caseous form has now given rise to cavities. As the pathologist points out, there is no true resolving form or true ulcerative form, yet, clinically, predominance of one form does exist, with the restriction that whenever a small cavity is present the exudative element should be disregarded and the case diagnosed as the caseous pneumonic and ulcerative form. Before surgical treatment, therefore, one must allow some time, as short as possible, to elapse in order that the form of the disease discloses itself. Hasty phrenic interruption and pneumothorax lead often to unwarranted belief in their value as cures. Pneumothorax and routine phrenicectomies are not the proceedure in acute stages. With lesions limited to one lung, even if extensive, collapse therapy is definitely indicated. There are no differences of opinion on this point. To be more specific in our consideration of the indications for surgical treatment, we shall group them under those for pneumothorax, those for a thoracoplasty, and those for plombage.

Indications for pneumothorax. — (i) Patients suffering from minimal to moderately advanced unilateral progressive lesions. Individuals in their teens or early twenties have shown the greatest response to this form of treatment. (ii) Where patients refuse to submit themselves to thoracoplasty, pneumothorax should be tried and proven inadequate, before giving up the case. (iii) When pneumothorax, having been tried, is giving good results, it should be continued for from four to five years if necessary and convenient. (iv) When the cavity is not of the thick fiibrous type and when pneumolysis, if required, is practical, we may and should expect success with this form of treatment.

Indications for thoracoplasty. — (i) When pneumothorax and phrenicectomy have proven worthless and it is considered safe to do this operation. (ii.) When it is not convenient for the patient to continue with pneumothorax for a long time, thoracoplasty should be done. (iii) When interpleural adhesions are too extensive to do an intrapleural pneumolysis. (iv) In empyema, which has not responded to aspiration and pneumothorax or drainage, thoracoplasty is definitely indicated. Especially is this true where active disease of the underlying lung is present, and in open empyema. (v) Thoracoplasty should be applied at once on an individual with the disease localized to the apex, without trying pneumothorax, because the percentage cures is highest with it and recovery most rapid. (vi) Where cavities are present in one lung, and productive tuberculosis in the other, unless the productive lesion is so extensive as to markedly decrease the respiratory field, there is no contraindication for thoracoplasty. (vii) If cavities are present in both lungs, operability depends on their extension and location. For instance, bilateral apical lesions lend themselves very well to bilateral apical collapse. With apical lesions in one lung and extended lesions in the other, provided the con-

dition of the patient is not too desperate, collapse should be done in the advanced apex. At a later date, collapse by any means may be applied to the other apex.

Indications for plombage.—(i) When an apex must be collapsed, and pneumothorax with its accessories has been inefficient, and when thoracoplasty is contraindicated by the poor general condition of the patient, plombage is indicated. (i) In bilateral apical cases with haemoptysis which must be controlled, the most advanced apex is collapsed by plombage, followed by apical thoracoplasty on the opposite side in about 3 weeks. (iii) When the opposite lung is extensively involved in the tuberculosis process, astonishing results have been obtained by plombage of the apex. Generally speaking, then, plombage is used to replace an inefficient pneumothorax when thoracoplasty is considered too drastic.

A brief note should be introduced on the indications for phrenic interruption and scalenectomy. Besides its use as an accessory to pneumothorax for aid in collapsing mainly central or basal cavities, but also apical ones, phrenic interruption has also been used, alone, with success in some cases of mild disease of the lower portions of the lung. Scalenectomy is, of course, always done as a part of the procedure in an apical thoracoplasty. It is considered at the present time that it has little value in other procedures. Phrenic interruption seems to be definitely contraindicated when thoracoplasty is to be done, since it increases paradoxical breathing.

Summary. As a final summary, these conclusions are submitted in agreement with a great majority of the workers. Pneumothorax, to-day, is still widely used with a great deal of success. Its application, however, to all patients is condemned, as is its long continued use in any one patient who is not showing satisfactory progress. On the other hand, thoracoplasty is taking a more important role than it has ever before enjoyed. With the realization that this operation may be applied with great success, both from the standpoint of high percentage cures and low mortality, even on a patient with disease in both lungs, one is not justified in saying that this patient cannot be cured or that the risk is too great if we submit him to this operation. The literature is full of astonishing results along this line. Corrylos, O'Brien, Alexander and many others have shown that thoracoplasty, if done on patients with small lesions, results in negligible mortality and a higher percentage of cures than any other procedure. Since thoracoplasty, if applied on a small and earlier lesion, does not give rise to disablement or deformity, its more extensive and earlier use is amply justified.

Pulmonary tuberculosis is such a protean disease and the results are so unexpected in many cases, that one must never shrink from an apparently desperate case. As O'Brien has so aptly said, "A surgeon should be judged not only on his percentage mortality, but also on his percentage of cures." It would appear, then, that it is more conservative to save the life of a patient even by radical means, than to jeopardize it by injudicious inactivity.

The author would like to thank Dr. Janes and Dr. Erb for their kindness and help in the preparation of this paper.